16.0 THE GERMAN WASTE WATER TAX (ABWASSERABGABE)

Introduction

A review of the German literature on the waste water tax shows that the tax has been subject to several detailed studies (Scholl, 1998). However, these studies have in the main had an analytical and somewhat theoretical character. A notable exception is the study by Sprenger et. al.(1997) which was mentioned in chapter 7. The federal German authorities have not yet commissioned a systematic ex-post evaluation of the waste water tax, but studies were carried out in advance to the introduction of the tax and there have been more anlytical legislative reviews in 1983 and 1994. Some of the difficulties with ex-post evaluation are due to the fact, that the tax is administered by the Länder authorities. Exact data on discharges and tax payments rest with the individual Länder authorities, and only the annual revenue is reported by the Länder authorities to the federal level. Some Länder appear recently to have commissioned studies of the effects of the tax, but no results are yet available. The Federal Statistical Agency (Statistisches Bundesamt), however, also collects and publishes detailed data on the industrial discharges and on investments for water pollution control. These data are used for the present study, and allow, with some reservations, for an empirically based ex-post analysis of the waste water tax.

16.1 Price and incentive effects

In chapter 7, section 3 (under 'Complementarity within portfolio of policy instruments'), the interplay between the regulatory framework (water household act and sector guidelines for discharges) and the abwasserabgabe was explained in more detail. For a proper assessment of the tax, it is crucial to acknowledge the delicate interaction between the regulatory framework and the tax. The emphasis in Germany is on the technical guidelines for discharges, as specified individually for about 100 industrial sub-sectors, and the tax is a supplementary instrument, used more or less as a penalty for non-compliance. (The reader should refer to chapter xx for a more complete explanation of the combination of policy instruments).

As outlined in the tier 2 study, there are supposed to be two main effects of the waste water tax. The first is to assure compliance with the technological guidelines, since the tax is reduced for dischargers which are in compliance. The second effect is a general incentive to reduce waste water discharges.

For a proper assessment of the tax, it is necessary to differentiate between public sewage treatment plants and industries.

<u>Public sewage treatment plants</u>

Since public sewage treatment plants do not act as profit maximising entities, we would not expect them to improve compliance beyond the technological guidelines. Hence, there is no general incentive for sewage treatment plants to reduce their discharges. Only the pass-on of

the tax to connected dischargers could produce such an incentive, and then only to the individual dischargers. But since the tax in case of compliance hardly exceeds 2 per cent of the total waste water costs, we can not expect this general incentive to be very strong. In fact, there is substantial 'noise' in the local variation of user charges, which far exceeds such a 2 per cent band.

For the sewage treatment plants the main incentive of the tax is therefore to remain in compliance with the technological guidelines. In case they fail to do so, the tax may increase the sewage bill with as much as 20-25 per cent (in case of lacking nutrient removal facilities, cf. Wimmer, 1995: 38).

Industries

For profit-maximising industries which have direct discharges to the surface waters, the tax provides an incentive both to remain in compliance with the technological guidelines, and possibly to reduce discharges where the marginal costs of abatement are less than or equal to the tax rate.

It was shown in the tier 2 study, that the tax rates, when converted from damage units, presently are equal to 27,50 DM (EUR 14,1) per inhabitant equivalent of COD, 2,80 DM (EUR 1,4) per kilogram of nitrogen and 23,33 DM (EUR 11,9) per kilogram of phosphorous.

The technological guidelines impose mandatory emission limits, that vary among industries. The industries are not free to choose their emission level, but are required to comply with the guidelines and according to their permits. The significance of this observation is that the technological guidelines impose a basic cost level. These costs are reflected in the environmental investments for either in-house sewage plants or for in-house cleaner technologies (water savings, changes in processes etc.).

In case of compliance, the tax rate is reduced with 50 per cent (previously the reduction was 75 per cent). It is only in case of non-compliance that the tax applies with the full rate, i.e. it has a penalising character.

To achieve a first-order impression of the significance of the tax we can compare its total revenue with the annual environmental investments related to water measures. The revenue of the tax in 1998 was 720 million DM (MEUR 367,2), of which approximately 40 per cent or about *288 million DM (EUR 146,9)* represents payments from industry. In comparison, the environmental investments in industry related to water quality were 1.603 million DM (MEUR 817,5). Hence the waste water tax represented an additional burden of about 1/5 of the command-and-control related expenditures for industry as a whole.

However, the tax revenue accrues from a smaller part of industry, i.e. the direct dischargers. Rügemer (1995) assessed that about 4.000 industries are liable to the tax. Among them are some of Germany's largest industries. One might ask whether they are disproportionately taxed, as compared to the indirect discharges. The latter are obliged to pay sewage treatment fees, so we should compare the burden of the Abwasserabgabe with that of sewage fees. In

Table 93 the Abwasserabgabe is calculated for a food processing industry liable to discharge guidelines according to the Water Household Act article 7a. Table 93 shows that in case of the food processing industry (dairy, meat) which is in compliance, the nominal tax rate will be about DM 3,10 (EUR 1,6) per m3 waste water. Since this tax rate is subject to a 50 per cent reduction in case of compliance, the actual average tax rate per m3 is DM 1,55 (EUR 0,79).

Table 93: Pollution concentration limits for some food processing industries (dairy, meat) and calculation of nominal Abwasserabgabe per m3 discharged (according to maximum allowed emission concentration)

Pollutant	**Requirements mg/l (or g/m3)**	**Requirements kg/m3**	**Tax rate DM/kg (EUR/kg)**	**Tax rate DM/m3 (EUR/m3)**
COD	110	0.110	27.50(14.1)	3.03 (1,55)
N (nitrogen)	10	0.010	2.80 (1.4)	0.03 (0,015)
P (phosphorus)	2	0.002	23.33(11.9)	0.05 (0,026)
Sum				3.10 (1,58)
with 50% reduction				1.55 (0,79)

The effective waste water tax (for direct dischargers) is sometimes compared with the sewage fee level for indirect dischargers (of about 4 DM (EUR 2)/m3), i.e. for industries connected to municipal sewage plants. Does the contrast between these imply, that there is a discrimination of indirect dischargers, who generally have to pay more per m3, than direct dischargers who are in compliance with the technical guidelines? No, not immediately, as the direct dischargers not only have to pay the tax, but also have expenditures for in-plant measures, own treatment or other, in order to comply with the guidelines. The technical guidelines that direct dischargers have to adhere to are generally not as strict as the ones for municipal sewage treatment plants (Hitchens et. al., 159-160). This could indicate some bias in favour of the direct dischargers, but on the other hand, the installation of plant-specific sewage technology can often be expensive because of the smaller scale. Much depends therefore on the ability to identify a cost-effective abatemement technology, and although there are some indications, it is not possible a priori to conclude that direct dischargers are favoured compared to industries connected to sewage treatment plants.

The main source of inefficiency appears to be the differences in guideline requirements among different industries and municipal sewage treatment plants. To avoid discrimination the tax would need to apply at a uniform concentration level, not one adjusted to individual industries and their circumstances.

16.2 Environmental effects

Data availability

Analysis is complicated by the absence of published data on damage units and on tax payments. However, an alternative dataset is available from the Statistisches Bundesamt (Federal Statistical Agency), i.e on waste water discharges in cubic metres of production specific waste water. Production specific waste water denotes the 'true' amount of waste water containing emissions, excl. cooling water. Although the data on production specific waste water differ from the damage units liable to taxation, there is reason to expect a good approximation between the COD-emissions and the amount of production specific waste water (Hudson et. al., 1981). Since the dataset distinguishes between direct discharges (liable to the tax) and indirect discharges (to public sewage treatment plants, and not liable) we can get a fair impression of the impact of the different incentives in place. For the direct discharges the dataset furthermore distinguishes between discharges where the manufacturer has installed his own sewage treatment and discharges that are emitted without further treatment. We expect the tax to help reduce the latter type of emissions. However, since direct discharges (cf. above) in most cases can be expected to be a cheaper alternative to discharge to a public sewerage system, we will expect there to be more marked reductions in the latter case.

Data for production specific waste water for the years 1977-1983 were kindly delivered by the Federal Statistical Agency upon request. Despite included in the questionaire they were not published prior to 1987. Data for the years 1987 to 1995 are available in the publications under Fachserie 19 (Umwelt) of the Federal Statistical Agency. Data for the year 1999 are expected to be published in late 2001.

The Federal Statistical Agency also publishes data on environmental investments for environmental purposes, and detailed data on waste, water, noise and air pollution control measures. Data on waste water discharges are collected every four years, while investment data are collected and published annually.

Time series analysis.

In the following time series are shown for the Federal Republic of Germany (FRG) as a whole (old Länder) and for individual industrial sectors ('Verarbeitende Gewerbe'; companies with 20 or more employees). Since 1991 industrial sector data are published only for the enlarged Germany. Since 1995 adjustments have been made in the sector classification system, and data has been regrouped according to the new systematic for the whole period. Data for developments in net production index are only indicatory, as they do not match the new 1995 classification system for industrial sectors, which it has been necessary to use in order to establish consistents timeseries for waste water discharges. Furthermore, the reunification of Germany impedes meaningful comparison to the net production index for 1991 and 1995.

Figure 7. FRG (old Länder) manufacturing industry: Discharges of production specific waste water (billion m3) 1977-1995 (Source: Statistisches Bundesamt, Fachserie 19.2.1.)

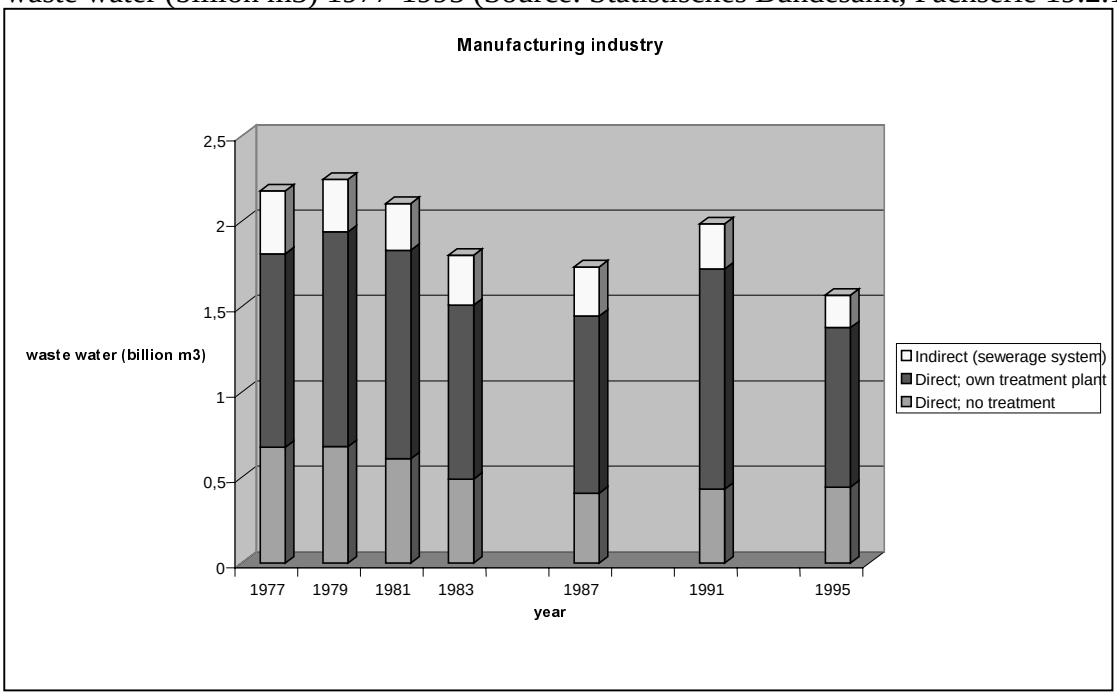


Table 94. FRG Manufacturing Industry: Index for discharges of production specific waste water from industries with direct and indirect outlets as compared to net production index

	1977	1979	1981	1983	1987	1991	1995
Direct	100	107	101	83	80	95	76
-no treat	100	100	90	72	60	64	66
-wSTP	100	111	108	90	92	114	83
Indirect	100	83	74	79	78	72	51
Total	100	103	97	83	80	91	72
Net production	100	107	106	103	114	*	*

Note: Direct discharges include discharges through own sewage treatment plants. Indirect discharges denote discharges to public sewage treatment plants. FRG-total, since 1991 includes New Länder. (*) reunification effect: break in time series.

Table 94 shows that for the discharges as a whole have been reduced 28 per cent from 1977 to 1995, i.e. to 72 per cent of the original level. It should be noted that the decrease in discharges begins in the same year as the Abwasserabgabe came into effect (1981). Although there is a close interplay between the tax and the command-and-control regulations (the sector guidelines for discharges), the tax is believed to have played a significant role, as very few of the mandatory sector guidelines under the revised water household act were in place in 1981; they were issued only subsequently (Andersen, 1994).

It can be seen in Table 94, that since 1977 indirect discharges have been reduced most

significantly, i.e. to 51 per cent or nearly half the original level. The direct discharges (liable to the tax) have been reduced less dramatically, but still by 24 per cent. However, within this category the direct discharges with no subsequent treatment have been reduced to 66 per cent of the original level, reflecting that many industries have installed their own treatment plants. These developments have taken place, while net production has increased considerably.

In the following a closer look is offered at selected industries. We begin with some of the traditional waste water dischargers, i.e food processing industry, textile industry and paper industry, but also offer data on some other important industries. In the following the data for 1991 and 1995 refer to FRG-16, while 1977-1987 refers to FRG-11.

Figure 8. Food processing industry: Discharges of production specific waste water (million m3) 1977-1995. (Source: Statistisches Bundesamt, Fachserie 19.2.1.)

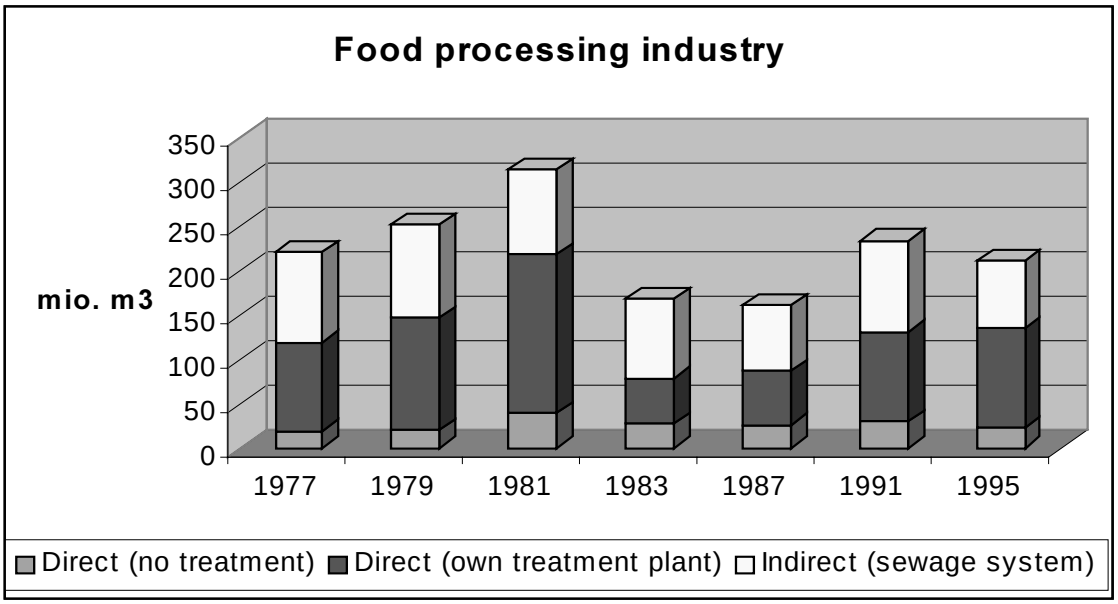


Table 95. Food processing industry: Index for discharges of production specific waste water from industries with direct and indirect outlets as compared to net production index

	1977	1979	1981	1983	1987	1991	1995
Direct	100	122	183	66	73	110	113
Indirect	100	103	93	89	73	101	76
Total	100	114	142	76	73	106	96
Net prod.	100	106	110	109	114		

Note: Direct discharges include discharges through own sewage treatment plants. Indirect discharges denote discharges to public sewage treatment plants. FRG-total, since 1991 incl. New Länder.

In the food-processing industry a dramatic decline in discharges took place from 1981 to 1983, after discharges had been on the increase during the 1970s. The main reason for this

decline (which was close to a reduction by a factor 2) seems to have been the developments in the sugar industries, with new waste water reducing measures.

Figure 9. Textile industry: Discharges of production specific waste water (million m3) 1977-1995. (Source: Statistisches Bundesamt, Fachserie 19.2.1.)

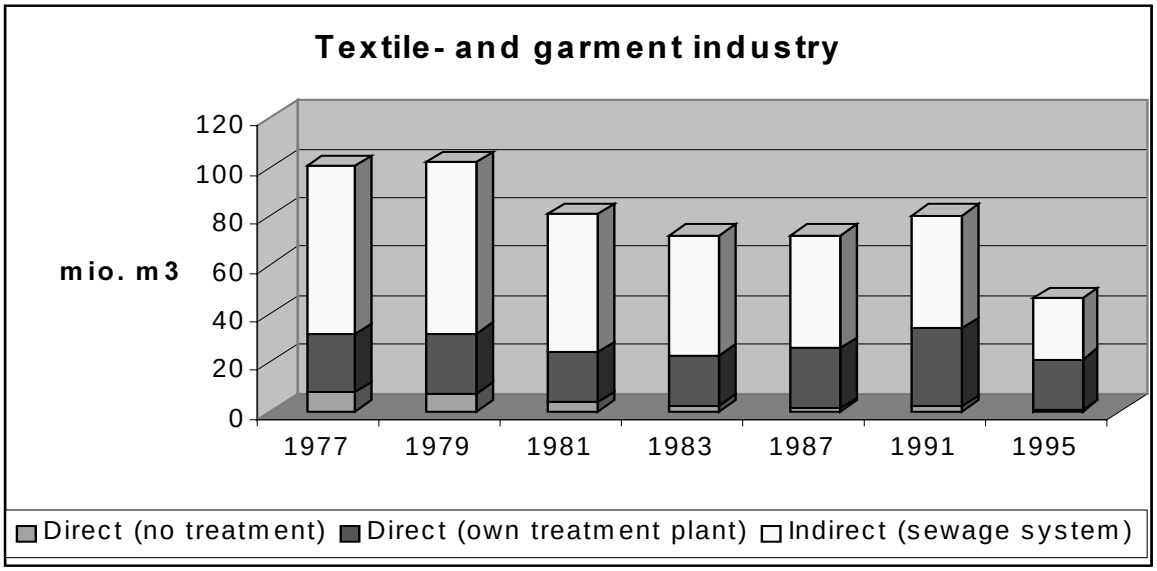


Table 96. Textile industry: Discharges of production specific waste water from industries with direct and indirect outlets as compared to net production index

	1977	1979	1981	1983	1987	1991	1995
Direct	100	101	76	72	81	107	67
Indirect	100	102	83	72	68	67	36
Total	100	101	80	72	72	80	46
Net prod.	100	100	91	87	93		

Note: Direct discharges include discharges through own sewage treatment plants. Indirect discharges denote discharges to public sewage treatment plants. FRG-total, since 1991 incl. New Länder.

In the textile industry the producers tend to be less favoured by permissions for direct discharges, as the manufacturers tend to be smaller and middle-sized enterprises.

The indirect discharges to municipal sewage treatment plants account for the greater part of discharges, and they are also the ones that have seen the largest reductions, from 1977 to 1995 with 2/3.

Direct discharges with no further treatment have been reduced markedly too, and overall the direct discharges have been reduced by one third.

Figure 10. Paper industry: Discharges of production specific waste water (million m3)

1977-1995. (Source: Statistisches Bundesamt, Fachserie 19.2.1.)

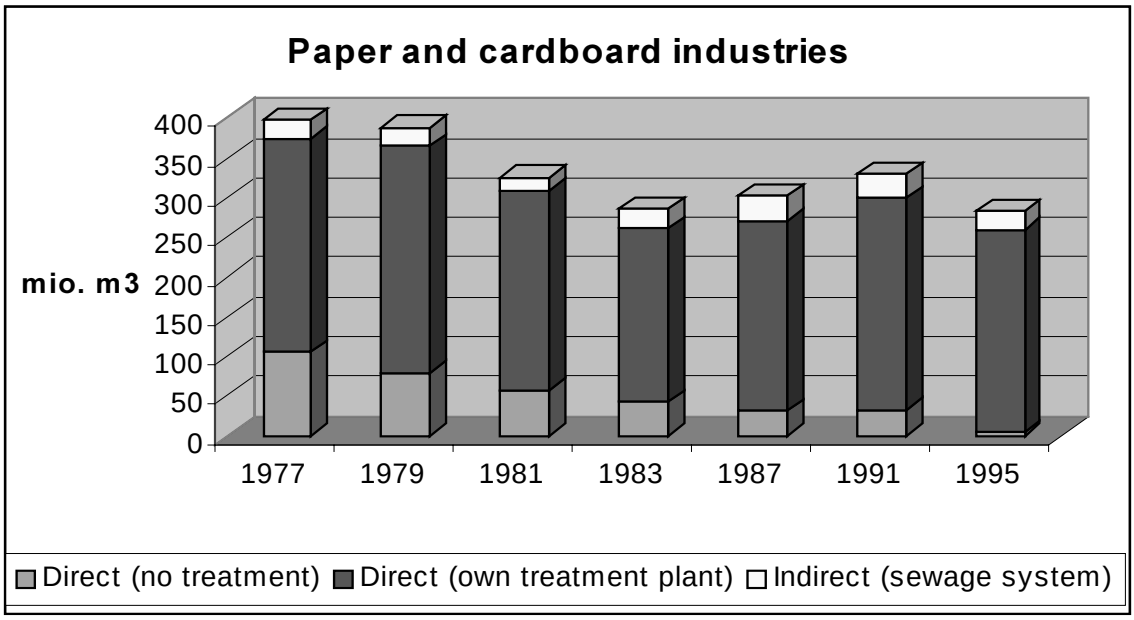


Table 97. Paper and cardboard industry: ***Discharges of production specific waste water from industries with direct and indirect outlets as compared to net production index***

	1977	**1979**	**1981**	**1983**	**1987**	**1991**	**1995**
Direct	100	98	82	70	72	80	69
Indirect	100	100	72	105	135	129	98
Total	100	98	82	72	76	83	71
Net prod.	100	111	117	123	132		

Note: Direct discharges include discharges through own sewage treatment plants. Indirect discharges denote discharges to public sewage treatment plants. FRG-total, since 1991 incl. New Länder.

Direct and untreated discharges have been reduced with 90 per cent, and in average the direct discharges, including that passing in-house treatment, have been reduced with 50 per cent.

The paper industry, which includes cellulose manufacturing, cardboard producing and printing activities, is like food-processing a waste water intensive sector. Discharges have been reduced tonearly 2/3 of the original level, despite the inclusion of the new Länder.

There are hardly any direct discharges that do not receive treatment any more, and this is the share of the discharges that shows the most marked reductions. COD-levels tend to be high in the paper industry, so we expect a good pay-off from reductions in untreated discharges. The indirect discharges, on the other hand, are small and at a relatively constant level. They do not play a big role for this industry and are often required where other technical options are not available.

Figure 11. Chemical industry: Discharges of production specific waste water (million

m3) 1977-1995. (Source: Statistisches Bundesamt, Fachserie 19.2.1.)

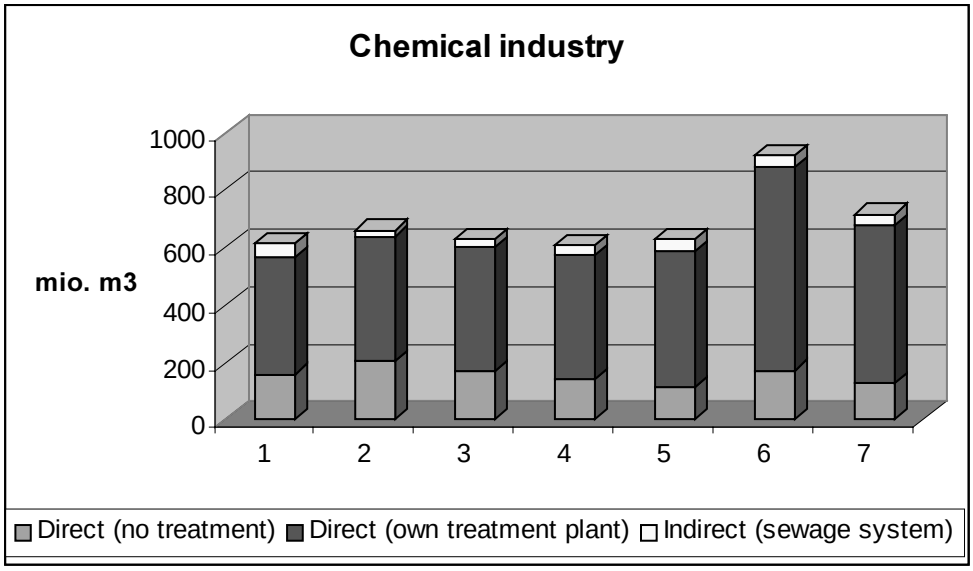


Table 98. Chemical industry: Discharges of production specific waste water from industries with direct and indirect outlets as compared to net production index

	1977	1979	1981	1983	1987	1991	1995
Direct	100	113	106	102	104	155	120
Indirect	100	42	57	59	88	85	72
Total	100	107	102	98	102	150	116
Net prod.	100	110	107	110	119		

Note: Direct discharges include discharges through own sewage treatment plants. Indirect discharges denote discharges to public sewage treatment plants. FRG-total, since 1991 incl. New Länder.

The chemical industry is an even larger discharger than food processing and paper combined, and its relative share has increased. While in 1977 it accounted for about ¼ of all discharges from industry, its share is now above 40 per cent.

The reunification may play a role for this relative share, but even in 1987 discharges had hardly been reduced in this sector compared to 1977.

The increase from 1987 to 1991 is believed to reflect the new contribution from the new Länder, and the reductions seen through the first part of the 1990s is believed to have taken place mainly in this area too. The decrease may hence reflect closure of some large polluters, rather than active pollution control.

Figure 12. Electric appliances' industry: Discharges of production specific waste water

(million m3) 1977-1995. (Source: Statistisches Bundesamt, Fachserie 19.2.1.)

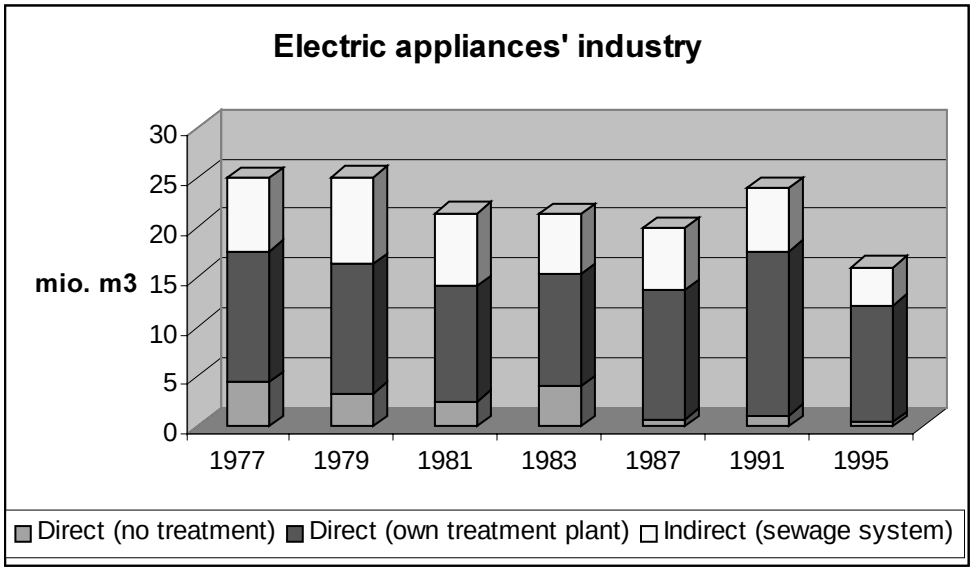


Table 99. Electric appliances manufacturing: Index of discharges of production specific waste water from industries with direct and indirect outlets as compared to net production index

	1977	1979	1981	1983	1987	1991	1995
Direct	100	93	80	87	78	100	69
Indirect	100	118	98	81	83	85	52
Total	100	100	86	85	80	96	64
Net prod.	100	106	109	109	136		

Note: Direct discharges include discharges through own sewage treatment plants. Indirect discharges denote discharges to public sewage treatment plants. FRG-total, since 1991 incl. New Länder.

Manufacturing of electric appliances is not a waste water intensive sector, and its share of total emissions is modest.

There have nevertheless been substantial reductions, not only in direct untreated discharges but also in the indirect discharges for municipal sewerage systems. Overall we expect these developments to be the result of active water pollution control policies.

Despite German reunification, the industry's emissions are well below the 1977 starting point.

Figure 13. Iron and steel industry: Discharges of production specific waste water (million m3) 1977-1991. (Source: Statistisches Bundesamt, Fachserie 19.2.1.)

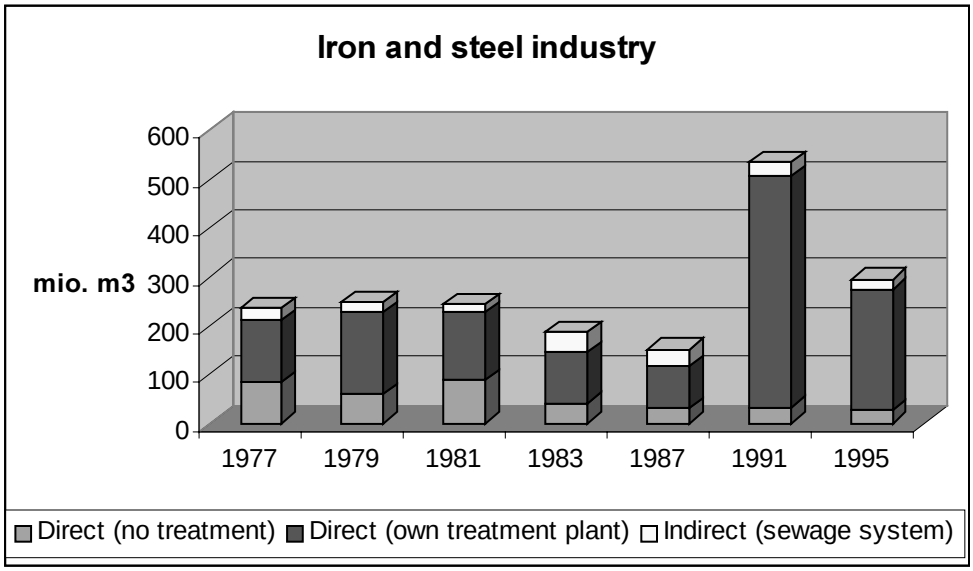


Table 100. Iron and steel industry: Index of discharges of production specific waste water from industries with direct and indirect outlets as compared to net production index

	1977	1979	1981	1983	1987	1991	1995
Direct	100	107	107	69	55	240	129
Indirect	100	89	75	168	146	118	86
Total	100	106	104	79	64	227	125
Net prod.	100	113	107	103	110		

Note: Direct discharges include discharges through own sewage treatment plants. Indirect discharges denote discharges to public sewage treatment plants. FRG-total, since 1991 incl. New Länder

Iron and steel production comprises a number of sub-sector from the Statistical Agency's systematic. In the past the iron and steel sector was a big polluter in terms of waste water, but this reputation now belongs to the past. Substantial reductions have taken place in the past two decades, in particular as regards the direct discharges, treated and untreated. From 1977-1987 both have been reduced by nearly a factor 2. Indirect discharges do not play an important role for this sector, and despite some ups and downs, display a net increase from 1977 to 1991. The increase in indirect discharges from 1981 to 1983 is somewhat surprising but is believed to reflect the impact of command-and-control regulations mandating public sewage treatment for some key dischargers.

Figure 14. Automobile industry: Discharges of production specific waste water (million m3) 1977-1995. (Source: Statistisches Bundesamt, Fachserie 19.2.1.)

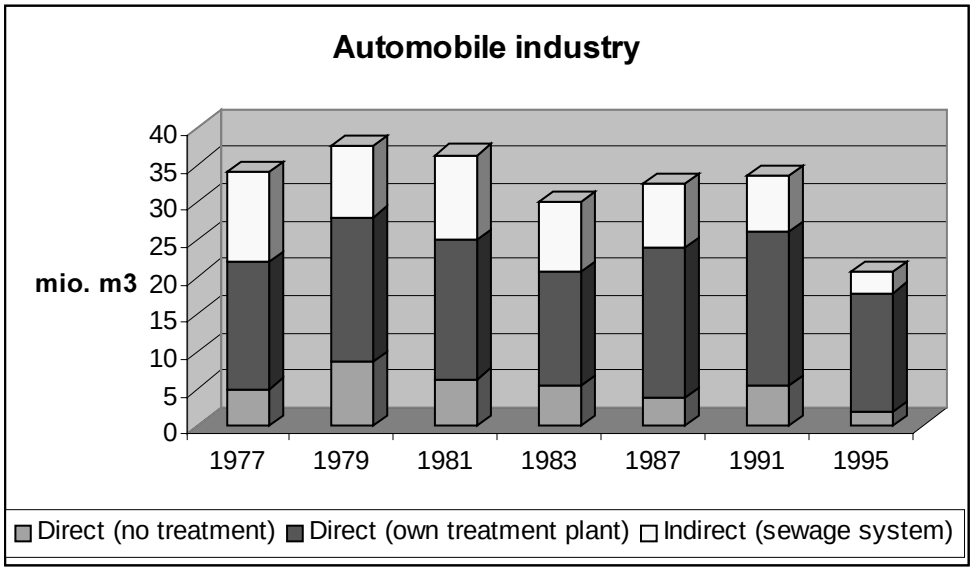


Table 101. Vehicle manufacturing: Index of discharges of production specific waste water from industries with direct and indirect outlets as compared to net production index

	1977	1979	1981	1983	1987	1991	1995
Direct	100	128	114	94	108	118	81
Indirect	100	78	94	76	72	63	23
Total	100	110	107	88	95	99	60
Net prod.	100	108	113	115	137	NA	NA

Note: Direct discharges include discharges through own sewage treatment plants. Indirect discharges denote discharges to public sewage treatment plants. FRG-total, since 1991 incl. New Länder

The automobile industry is also one of the smaller polluters, but like the manufacturers of electric appliances they have been able to undertake significant reductions in waste water discharges.

However, in this industry it is particularly the indirect discharges that have been reduced, whereas the direct discharges are merely 20 per cent below the original level. The net effect is a reduction to 60 per cent of the original level, despite German unification.

Summarising observations

In relative terms, the most significant reductions have taken place in some sectors which are not very waste water intensive, while in absolute terms it is naturally sectors such as food processing and paper manufacturing that have contributed the most. It is somewhat surprising that the chemical industry and the iron and steel industries - while following a pattern of relative decline in discharges from 1977-1987 - are well above the original level in 1995.

Obviously the reunification is rather crucial factor for that development, because figures in 1991 and 1995 include discharges in the new Länder. The former emphasis on heavy industry in the eastern Länder had accorded them with very large metallurgical and chemical complexes, which weigh relatively substantially in the national statistics of discharges. Nevertheless, it should be observed that the declining trend in the old Länder in the 1970's was less dramatic than in for instance the paper- and pulp industry for these two industries.

16.3 Competitiveness effects.

Data availability

The impact on competitiveness of the *Abwasserabgabe* is not easily discerned. Theoretically, and if everything else was equal, an industry in a country which imposes a tax will suffer a relative loss of competitiveness. The loss of competitiveness will be equal not only to the financial burden of the tax but also to the investments necessary to escape the tax where the marginal abatement costs make it more profitable to undertake pollution control, than to pay the tax. Such investments in turn entail operating expenditures. In fact, Jaffe et. al. (1995) have identified the investments and operating expenditures imposed by environmental regulations as the major components to take into account to assess the competitiveness effects. To these items we may add the tax payment itself.

However, the impact on competitiveness of the *Abwasserabgabe* is not easily discerned. In the German case the tax must be seen not as a regulatory tax as such, but rather as a penalty tax, which is imposed most consequently on polluters not in compliance with the sector guidelines of the water household act. This means that the regulatory requirements for water pollution control are there in advance, and that requirements for investments and operating expenditures follow mainly from the command-and-control regulations, and not from the tax *per se*. Of course one could argue that polluters would have little reason to comply at all, had the tax not been there, and that hence all costs should be accrued to the tax.

Below we take the approach to identify the investment and operating expenditure for water pollution control, and we try to assess the size of the *abwasserabgabe* in relation to these expenditures.

Jaffe et. al. (1995) stress that these cost components are those items which are relevant from the static point of view. The static view excludes possible advantages that accrue from more efficiency in water consumption, as induced by the tax. The study by Sprenger et. al. (1998) (see the tier 2 section) showed that such advantages were present in some German industries as compared to Italian and Irish competitors. The value of improved water efficiency can be identified as the immediate savings in water costs for water supply, sewage and environmental control.

An encompassing analysis of competitiveness effects would need to analyse to which extent water pollution control costs in Germany exceed those present in other industrialised countries. We here limit the study to the German situation, but refer the reader to a previous study (Andersen, 1984), which showed that water pollution control investments in Germany

in the 1970's and 1980's were at a similar level as in the Netherlands, France and Denmark (The study also indicated, that sewage treatment was more extensively subsidised in the FRG, than in the other countries). The EU's Urban Waste Water Directive has now made 'northern standards' for sewage treatment compulsory for all of the Union, and will hence result in matching costs for these measures in all member states. It is therefore unlikely that Germany's basic investment and operating expenditures will deviate much from that of other member states

The purpose of the present analysis is hence to identify the burden of the abwasserabgabe relative to the investment and operating expenditures for water pollution control.

Investments for pollution and water pollution control

In 1995 the total investments in German manufacturing industry (excluding mining and public utilities, but including new Länder) amounted to 88 billion DM, of which investments related to pollution control amounted to nearly 4 billion DM. Of these there were about 1,4 billion DM which were related to investments for water pollution control. The share of environmental investments of the total investments was hence 4,5 per cent, and the share of water pollution control investments of total investments was 1,5 per cent.

These investment levels have been fairly constant since 1980, although the investment level differs by sector.[1] Total environmental investments have fluctuated between 4 and 5,5 per cent since 1980. Investments for water pollution control have fluctuated between 1 and 2 per cent, mostly around and above 1,5 per cent – since 1980 and up to 1995. Unification did not result in significant changes in the overall investment level, but a decline might have been seen without it.

Below the figures 8-10 give the data for total environmental investments and for investments in water pollution control for the manufacturing industryFigure 15 presents the Total Environmental Investments by the manufacturing industry as a whole and broken down by (9) individual sectors. Figure 16 shows the water pollution investments by the manufacturing industry as a whole and broken down by (9) individual sectors. To highlight the significant contribution by the chemical sector, Figure 17 presents the same data as Figure 16 for the manufacturing industry excluding the chemical sector, and broken down for the (non-chemical) 8 individual sectors.

The chemical sector again stands out against the other sectors, however with a much higher level of (total) environmental investments (see Figure 15). While most sectors experienced environmental investments share ranging from 2 to 5% of total investment, the chemical industry's environmental share of total investments increased from 9 to 16% in 1991.

It is to some extent the water pollution control related investments which explain the high investment level in the chemical Water pollution control generally accounts for about half of

[1] The figures for environmental investments do not include all process-integrated investments (cleaner technologies) but only those eligible for the special tax provisions for environmental investments. Mainly it is end-of-pipe investments which are included.

the chemical industry's investments. They peaked in 1989 with 7,3 per cent, and decreased then to only 3 per cent in 1995. Hence, Figure 15 suggests that ramping up of the Abwasserabgabe after 1993 do not seem to have induced additional investments in the manufacturing industry as a whole.

Figure 15 Total Environmental Investments of Manufacturing Industry and 9 sectors

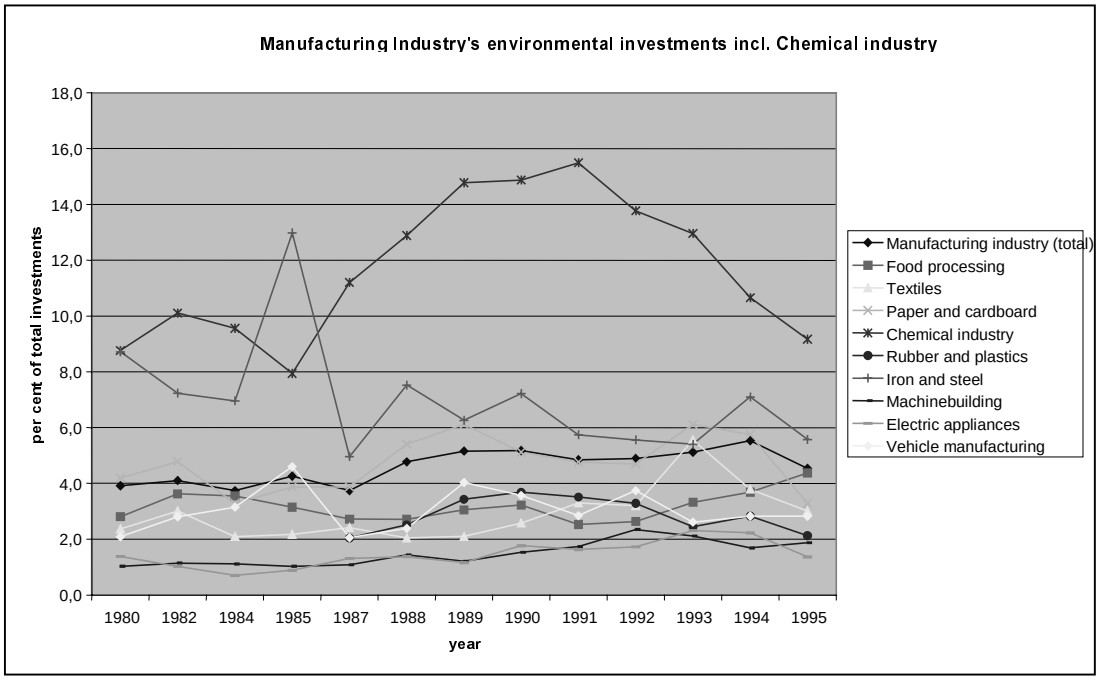
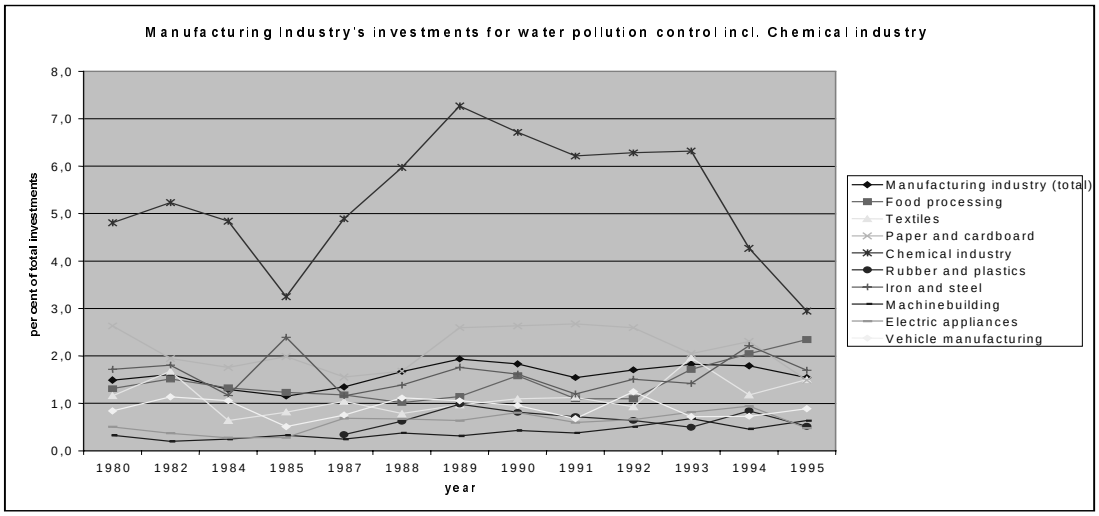


Figure 16 Investment in Water Pollution for Manufacturing Industry and 9 sectors

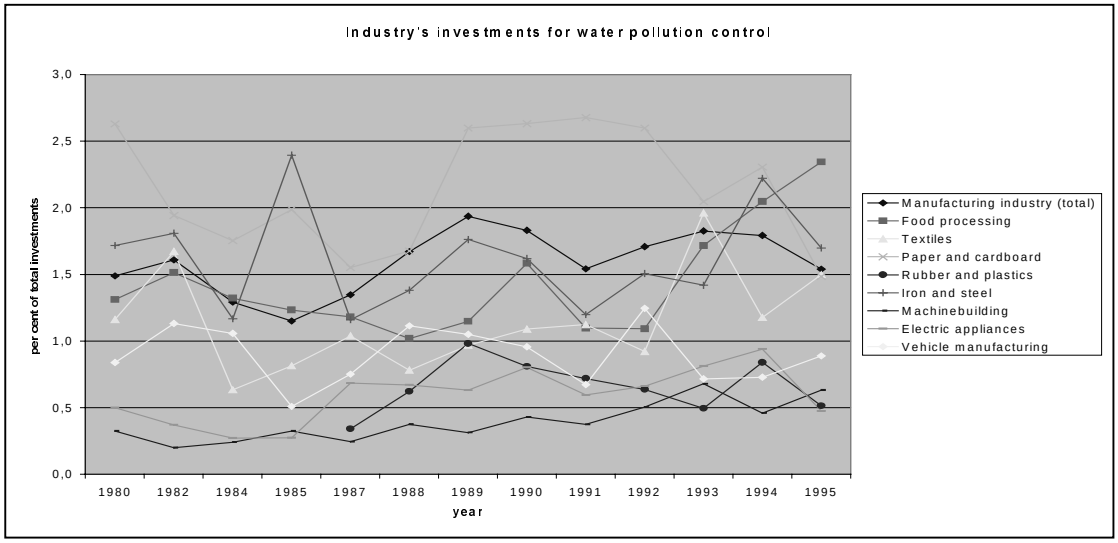


However, if we exclude the chemical industry (see Figure 17) from the manufacturing industry, a closer look at the water-related investments patterns in the remaining sectors is

possible:

- The pulp and paper industry generally had a somewhat higher water-related investment share as compared to the other sectors: 2 to 2,5% of total investments.
- Machine-building, electric appliances, rubber/plastics and automobile manufacturing sectors experienced water-related investment levels of 1% of total investment.
- In the remaining three sectors – food processing, textiles and iron/steel water pollution control investments increased between 1980 and 1995 from the lower band towards the level of the pulp and paper industry. These three sectors also experienced the highest level of total environmental investments after the chemical industry.

Figure 17 Water Pollution Investments, Manufacturing Industry minus Chemical



Sector

Operating expenditures and Abwasserabgabe

The operating expenditures for water pollution control for manufacturing industries amount to 6,6 billion DM annually, with the following five sectors accounting for 2/3 of the expenditures: chemical industry (1,9 bn. DM), iron and steel (0,7 bn. DM), food processing (0,7 bn. DM), automobile industry (0,6 bn. DM), and pulp and paper industry (0,4 bn. DM).

We can estimate that the Abwasserabgabe is liable for individual industrial sectors from the statistics on waste water discharges. The manufacturing industries discharged (1995) 444 million m3 waste water with no treatment and 933 million m3 waste water through own sewage treatment plants, i.e. altogether 1.377 million m3.

If these discharges only contain COD and no other emissions, and if all discharges comply with the technical guidelines, the maximum tax that is liable is 1.377 million m3 x taxrate. Untill 1998 the tax rate was reduced by 75 per cent, so if we want to estimate the maximum tax revenue and compare it with actual data for 1998 it is 1.377 million m3 x 3,05 DM x 25%, the result of which is 1.049 million DM.

However the actual tax revenue collected from industry in1998 was estimated to be only 288 million (Table 102), which means that actual discharges in average must have been well below the guideline values. The operation of own sewage treatment plants at many industries support this observation.

Since the abwasserabgabe for industry is only about ¼ of the maximum(288 of 1049 million), and in any case is a rather modest burden, we simply calculate a mean value for the tax for each sector by reducing the calculated value to ¼ and multiply with the direct discharges of waste water that are liable to the tax.

Table 102 Water-pollution Costs to Industry: Total, Investments, Operating Expenditure, Abwasserabgabe, and share of total, per sector, Billion DM (EURbn),1998

Sector	Total	Investment	(%) total	Operating exp.	(%) total	Abwasser-abgabe	(%) total
Manufacturing industry, total	8,309 (4,238)	1,358 (0,693)	16	6,663 (3,398)	80	0,288 (0,147)	3
Chemical industry	3,072 (1,566)	0,336 (0,171)	11	2,616 (1,334)	85	0,120 (0,061)	4
Iron and steel	0,918 (0,468)	0,163 (0,083)	18	0,739 (0,377)	81	0,016 (0,008)	2
Food processing	0,997 (0,508)	0,234 (0,119)	23	0,741 (0,378)	74	0.022 (0,011)	2
Automobile industry	0,858 (0,4375)	0,259 (0,132)	30	0,596 (0,304)	69	0,003 (0,0015)	0
Pulp and paper	0,535 (0,273)	0,087 (0,044)	16	0,401 (0,205)	75	0,047 (0,024)	9
Other						0,081 (0.041)	2

It follows from Table 102 that the burden of the abwasserabgabe is very small compared to the actual investments and the operating expenditures on water pollution control, in average only about 3 per cent of all the water pollution related costs, and with a variation from practically zero in the automobile industry and up to 9 per cent in the pulp and paper industry – which with the chemical industry is the industrial sector most 'affected' by the tax. Since there are practically no direct discharges from the pulp and paper industry that do not receive own treatment, there is reason to believe that the 9 per cent is an upper bound value for the cost implication of the tax. Conversely, because of the share of direct discharges with no treatment in the chemical industry, the 3 per cent could be a lower bound value.

16.4 Conclusions

Most German analysts are careful to assign to the abwasserabgabe any strong regulatory effect. "In comparison with the theoretical model, the waste water tax is today an instrument,

whose function is very complex and difficult to understand properly, due to the reliance on theoretically under researched elements and the dependence on other instruments"(Scholl, 1998: 157). Scholl undertakes an advanced, but also rather theoretical analysis, of the dynamics of the tax and the interplay with the waste water standards, and with different behavioural assumptions as regards the decision-making situation of the firm.

Krämer (1995) argues that the main effect of the tax was an intangible one: 'capacity building', i.e. the improvement of administrative competence, that was conceived to be deficient at the time the tax was introduced (the implementation deficit). The tax helped in making the regulatory policy more effective by:

- Providing earmarked financial means for building up permit giving, monitoring and modelling the quality of rivers and aquifers,
- Strengthening the position of environmental authorities vis-à-vis emitters and intensifying their interaction,
- Introducing into the relationship between authorities and emitters the objective elements of control and enforcement associated with fiscal legislation,
- Providing emitters with an incentive to review their discharges, and to consider technological options for reducing these,
- In municipalities sewage treatment attracted more attention and recognition, taking it out of its isolation in technical departments, and devoting more prestige to it,
- Finally it showed the legislators' determination to carry out its policies more effectively.

To appraise the role of the tax independently from other instruments, it would require detailed data at firm level, and the actual emissions for one or more Länder. In the present analysis we have chosen to rely on the only data available from the Federal Statistical Office. Even though specific waste water production data was available, it does not allow the same level of detail that could have been achieved if data on actual discharges according to the emission parameters of the tax had been available.

Clearly there have been substantial effects of water pollution control policies. In 1995 water discharges from German industry were nearly 1/3 lower than those in the 1970s in the territory of the old Länder. Despite the inclusion of new Länder, discharges from most industrial sectors are nowadays lower than they were 25 years ago. The major exceptions are the chemical the iron and steel industries although their discharges have declined too after they were boosted by reunification.

The industrial sector guidelines have established different discharge requirements for different industries, according to the technological options. Because the waste water tax is linked to compliance and the command-and-contrail regulations, there are effectively different tax thresholds for different industries. Food processing has a higher tax rate per cubic meter of waste water, than chemical industry and iron and steel industry. It has been shown that there is a systematic variation in the delinkages achieved between waste water and net production output, and the effective tax rates (Andersen, 1994: 142). This relationship indicates that the achievements in waste water reductions are not incidental, but that the level of tax pressure induced by the waste water tax has had a systematic effect.

As regards the effects on competitiveness, water pollution control has been one of the most demanding areas of pollution control, but presently the investments for water pollution control are at a modest level, approximately 1,5 per cent of total environmental investments. This figure differs among industries, however. In the chemical industry, water pollution control has required a higher level of investment, although recently it has declined to a level of 3 per cent of total investments.

The control costs consist of both investments and operating expenditures, and the latter are the most significant. They are induced in the main by the regulatory requirements, and although the tax may help to improve compliance, the costs it induced in terms of tax payments are extremely limited. It is estimated that the revenue of the tax from industry was about 288 million DM in 1998, and the tax payment itself made up in average 3 per cent of the total environmental compliance costs for industry. The sector most affected by the tax is the pulp and paper industry, where it may account for as much as 9 per cent of the water pollution control costs. It is the chemical industry which is liable to the largest tax payment, about 1/3 of the revenue stems from this sector.

It seems a paradox, that while the chemical industry has undertaken the largest investments in water pollution control, it remains also one of two sectors, in which the decline in discharges has been very modest. The reason lies not only with reunification, but also with the properties of the effluent of chemical industries. Many of the control efforts are believed to have related to specific toxic emissions, and are not so adequately captured by the pooled parameter of production specific waste water.

To sum up, the environmental effects of the tax can not be clearly specified, but when assessed with countries without a tax instrument, it is clear that it plays a significant role even in its limited function as a penalising tax. At the same time the competitiveness effects of the tax itself is quite limited, as the tax amounts to just 3 per cent of the total water pollution control costs in industry.